ORIGINAL ARTICLES

Plagiarism Education in Science: The Effect of Instruction on Student Attitudes

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Abstract

In scientific publications, plagiarism is an ethical breach that can lead to article retractions and damage the reputations of scientists. Therefore, in academia, when students are beginning their scientific careers and learning the norms of scientific research, teaching the concepts of plagiarism is critical. However, a lack of clarity exists regarding the nuances of plagiarism, student understanding of plagiarism, and how universities should address instances of plagiarism committed by students. This study was conducted at University of The Bahamas with the objective of measuring the effectiveness of plagiarism instruction on student understanding and perceptions of plagiarism. Over five semesters, a total of 110 students participated in this study by attending a class on plagiarism, which included a lecture, an activity, and a discussion, and by completing out-of-class assignments designed to support the information learned in class. Before and after plagiarism instruction students completed questionnaires that were designed to assess their understanding, attitudes, and opinions regarding plagiarism in general and at the University. Following the class, students indicated a greater understanding of plagiarism, more agreement with stricter penalties for plagiarism, and less agreement on the acceptability of reusing past assignments. Students also reported a lack of clarity in the University policy on plagiarism. These results suggest that University of The Bahamas would benefit from providing additional learning opportunities pertaining to plagiarism, as well as a clearer definition of plagiarism in the *Policy on Plagiarism*. Strong plagiarism policies promote greater clarity and understanding of the concepts and assist university students as they embark on their scientific careers.

Introduction

To advance science, the presentation of novel ideas that are well researched and clearly communicated is critical. As the discipline of science grows more competitive and interdisciplinary, identifying and preventing misconduct become increasingly important (Antes et al., 2009; Anderson & Steneck, 2011; Pupovac & Fanelli, 2014). Plagiarism is a violation of the principles of science and a serious example of misconduct in the discipline (Anderson & Steneck, 2011). However, despite the consequences within the profession, plagiarism remains a pernicious problem in many universities (Zhang & Jia, 2012).

Plagiarism can be particularly persistent, as many believe they understand the concept, when in practice, plagiarism can be nuanced and subject to different interpretations. While the exact definition of plagiarism is not clearly defined (Anderson & Steneck, 2011; Baker-Gardner & Smart, 2017; Bennett, Behrendt & Boothby, 2011; Bouville, 2008; Pincus & Schmelkin, 2003), the generally-accepted definition is "the appropriation of another person's ideas,

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processes, results, or words without giving appropriate credit" (U.S. Office of Science and Technology Policy, 2000, "Research Misconduct Defined," para. 7). The misrepresentation includes the lack of an appropriate citation, whether intentional or not (Anderson & Steneck, 2011). Although academics and researchers often agree on the general concept of plagiarism, the above definition is recognized as being overly general and simplistic (Thomas, 2004). Furthermore, the many facets and variations of the concept mean that it can be challenging to define (Halupa & Bolliger, 2013). Therefore, a clear definition of plagiarism is essential.

The emphasis of plagiarism in most disciplines is focused on copied words. In contrast, scientific publications focus on the originality of ideas, as this discipline places a strong emphasis on who first published a finding and what the factual basis of the information is (Biagoli, 2012; Bouville, 2008). Therefore, the issues of plagiarism in science concern the origin of both words and ideas. Although plagiarism typically does not distort the scientific findings, the act of plagiarism can seriously jeopardize the authors' reputations and careers (Fanelli, 2009).

In academia, different instructors can interpret plagiarism differently (Bennett et al., 2011), and, if a university does not have a clear definition, those interpretations can vary even more greatly. Halupa and Bolliger (2013) found that in many instances university plagiarism policies were lacking, and many faculty and students did not fully understand what constitutes plagiarism. Gullifer and Tyson (2014) found that students were uncertain regarding what constitutes plagiarism and that approximately half had not read their university policy. University-level instruction pertaining to plagiarism is particularly valuable, as this ensures that students learn the concept, including the ethical expectations within the discipline, which is critical for their careers (Anderson, Louis, & Earle, 1994). Often, professors assume that students fully understand the concept plagiarism, while in truth many students and faculty are not explicitly aware of what constitutes plagiarism. In particular, students often lack clarity on how to appropriately cite material (McCabe, Treviño, & Butterfield, 2001). Students may develop their ethical norms based on their observations of how universities handle plagiarism and ethical misconduct. Therefore, including ethics instruction in scientific programs can enhance students' understanding in ways that will benefit their careers (Swazey, Anderson, & Lewis, 1993).

One particularly challenging and controversial issue pertaining to plagiarism is that of self-plagiarism, or reusing one's own words in more than one publication or work. In scientific research, self-plagiarism is widely viewed as unacceptable, as many believe that each publication should be original (Garner, 2011). Self-plagiarism therefore can lead to article retraction and penalties and can jeopardize careers (Fang, Steen, & Casadevall, 2012; Grieneisen & Zhang, 2013). In academia, the issue of self-plagiarism can be more controversial. Some believe that reusing previously submitted material can help students to build on ideas, further develop their writing, and improve their final product. However, others believe that students should always submit original assignments, without having the benefit of previous instructors' comments, edits, and grades (Halupa & Bolliger, 2013).

In recent years, the rise of plagiarism-prevention tools, such as *Turnitin*, *SafeAssign*, and *iThenticate*, has resulted in the more frequent detection of plagiarism and self-plagiarism (Halupa & Bolliger,

2013). However, relying on these tools alone is not the most effective way to combat plagiarism; instead, they should be used in concert with human readers, such as the authors, editors, and reviewers (Gasparyan et al., 2017). Consensus on how best to provide ethics instruction to prevent plagiarism prior to submission is lacking. Brown and Janssen (2017) found that a plagiarism "intervention" was successful in reducing instances of plagiarism at their university. Nonetheless, instruction often is ineffective, and few studies have examined the effectiveness of plagiarism instruction (Antes et al., 2009). Understanding how to inform students about the many facets of plagiarism is critical to effectively teach them about ethical misconduct and to provide the students with the best chances for career success.

In low- and middle-income countries, plagiarism is often a problem, but little has been done at the country-level to address the problem (Ana, Koehlmoos, Smith, & Yan, 2013). In the Caribbean, instances of plagiarism are on the rise, but information on the motivation for and understanding of plagiarism is necessary (Baker-Gardner & Smart, 2017; Walcott, 2016). The majority of universities in the Caribbean have a policy on plagiarism (Baker-Gardner & Smart, 2017), although the existence of a policy does not necessarily indicate that students are aware of the policy or understand the concepts.

In The Bahamas, information on plagiarism at the university level is not widely available. The primary degree-granting institution in the country is University of The Bahamas, chartered in 2016 and initially established as the College of The Bahamas in 1974. The University's *Policy on Plagiarism*, written in 1985, outlines the definition of plagiarism, as well as the penalties for plagiarizing at the University. The *Academic Policy Handbook* defines plagiarism as "the unacknowledged use of another person's work" (College of The Bahamas, 1985, Sect. 1.2). As stipulated in the handbook, penalties for plagiarism include a written note to the department chairperson for the first and second instance, as well as the additional following penalties for up to three instances: 1) plagiarized material will be excluded from grading; 2) a failing grade on the paper; and 3) expulsion from the University (College of The Bahamas, 1985). Despite the existence of this policy, however, the understanding of University policy varies among faculty and students, and faculty do not necessarily follow the penalties outlined by the University when instances of plagiarism arise in their classroom. The policy has not been updated since 1985, but the University is currently planning to update the policy in the 2019 academic year (M. Oriakhi, personal communication, May 31, 2019).

Anecdotal evidence from students at University of The Bahamas suggests that plagiarism is prevalent in the University environment, although limited studies have been conducted to better understand the perceptions of plagiarism and to determine the effectiveness of plagiarism instruction (Gibson, Blackwell, Greenwood, Mobley, & Blackwell, 2006). To address the issue of plagiarism in science at the university level, this study was developed to assess student understanding and opinions on plagiarism at University of The Bahamas. The goal was to determine what student perceptions of plagiarism are and whether those perceptions could change as a result of specific instruction. The objective of this study was to measure how student understanding and perceptions of plagiarism changed following instruction and discussion.

Methods

This study focused on upper-level students at University of The Bahamas enrolled in research methods classes in the School of Chemistry, Environmental, and Life Sciences. Data were collected over the course of five semesters during three academic years from fall 2016 to fall 2018. The same instructor directed the class on plagiarism in all five semesters. The first semester course was a research methods class in the Small Island Studies Department, while the four subsequent classes were in the Biology Department (see Table 1 for the number of students and surveys each semester). Over the course of the five semesters, 110 students participated in this study. The majority (79%) of students were female, and, with the exception of 6 sophomores, all students were of junior or senior standing. Due to absences, the total number of pre- and post-surveys completed may have varied slightly from the number of students enrolled in the class.

These research methods courses were designed to provide instruction on the research process and how to conduct independent research projects, as the students are preparing for a career in science. While plagiarism is traditionally discussed during orientation and taught in the first-year Student Counselling Seminar and English writing courses, this topic was specifically addressed in the Research Methods class, as this course is seen as a platform for beginning the research process, and students learn how to write for scientific publications. The lesson on plagiarism occurred as a component of an ethics module.

As part of this study, the students participated in one class per semester on plagiarism and were surveyed using a Plagiarism Attitude Survey before and after the class to assess changes in perception and understanding. The Plagiarism Attitude Survey was a written questionnaire adapted from a survey written by the Online Writing Laboratory at Purdue University (Elder, Pflugfelder, & Angeli, 2012). To gauge baseline student perceptions and understanding, the pre-survey was first disseminated to students at least one week before the class on plagiarism, before the readings or assignments were assigned to the class (See Figure 1).

Table 1
Number of students participating in this study on plagiarism in scientific research methods classes at University of The Bahamas.

Semester	Department	Number of students enrolled	Number of pre-surveys completed	Number of post-surveys completed
Fall 2016	Small Island Sustainability	11	10	8
Spring 2017	Biology	28	27	26
Fall 2017	Biology	27	22	24
Spring 2018	Biology	23	23	22
Fall 2018	Biology	21	18	18
Total Number of Students		**110**	**100**	**98**

The post-survey was administered in the following class. This survey consisted of 14 questions designed to assess students' opinions and attitudes towards plagiarism, ethics, and the University's policy on plagiarism. The answers were recorded using a Likert scale, with responses including *strongly agree*, *agree*, *neutral*, *disagree*, and *strongly disagree*.

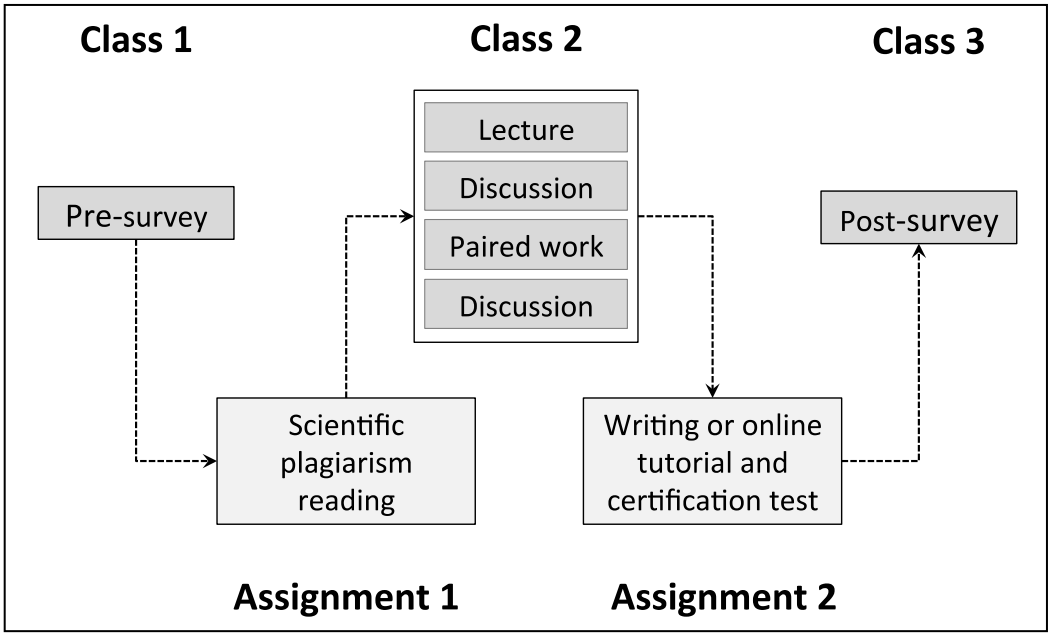

Figure 1. A depiction of all activities that were conducted as part of this study on plagiarism at University of The Bahamas.

In advance of the class on plagiarism, students were given readings on defining and avoiding plagiarism. In addition, during the first two semesters (Fall 2016, Spring 2017), students had to write a critical essay on plagiarism and its prevalence at the university level. In the last three semesters (Fall 2017, Spring 2018, Fall 2018), in lieu of the written assignment, students were required to complete an online plagiarism tutorial through Indiana University (Frick et al., 2016), which includes videos, plagiarism examples, and practice exercises. Within three days of the plagiarism class, students were required to submit a certificate indicating completion of the tutorial with a passing grade on the certification test.

During the plagiarism class, the instructor conducted a lecture for the first half of the class period, providing additional information on how to define plagiarism, how to properly cite sources, tips to avoid plagiarism, and information on the University policy on plagiarism. The second portion of class time involved a discussion, in which several scientific writing samples were given to students, who had to identify whether the samples were plagiarized and the type of plagiarism. Following this activity, student pairs independently completed a worksheet that provided examples of original scientific texts, along with examples of student writing excerpts referring to these texts, to identify whether these examples utilized proper citations. The

results of the independent paired work were discussed as a group.

To analyse results from the Plagiarism Attitude Survey, responses to the Likert scale survey questions from both pre- and post-surveys were coded, with numbers corresponding to the different responses (e.g., 1 = *strongly agree*, 3 = *neutral*, 5 = *strongly disagree*). To ensure honesty in reporting, surveys were conducted anonymously, and therefore individual responses from pre- and post-surveys could not be compared to gauge each student's change in perceptions and understanding as a result of the class. Following the entry of coded responses, an unpaired student's t-test was used to calculate the mean of the coded responses for each question, comparing pre- and post-instruction responses. Statistical analyses were performed using the statistical package R (version 1.1.453).

Results

Comparing student responses before and after the class on plagiarism, statistical analysis revealed that the students' opinions and understanding significantly changed ($p < .05$) for five of the 14 questions. In response to whether the students believed they understood what constitutes plagiarism, the average response was 2.37 (between agree and neutral, $\sigma = 0.87$) before instruction compared with 1.73 (between strongly agree and agree, $\sigma = 0.70$) after instruction ($p < .001$). Of the respondents, 60% answered positively to this question before instruction, compared with 90% after instruction (Figure 2a).

The second question covered the topic of self-plagiarism and asked whether the students felt that reusing a past writing assignment is acceptable. The majority of students agreed that this practice was acceptable before the class ($\mu = 2.50$, $\sigma = 1.12$), but afterwards, the majority shifted to disagree ($\mu = 3.35$, $\sigma = 1.19$; $p < .01$; Figure 2b). The third question that revealed a significant shift in student opinion was whether the students felt that others would be deterred from plagiarizing if the punishment were to receive a special grade on their transcript. In the pre-survey, students had agreed with this statement ($\mu = 2.03$, $\sigma = 0.94$), but after the class they agreed more strongly ($\mu = 1.76$, $\sigma = 0.85$; $p < .05$; Figure 2c).

The responses to the final two questions concerning the plagiarism policy at the University exhibited an observable shift in opinion. In the first of these questions, the students were asked whether the plagiarism policy at University of The Bahamas is clear. Before the class, the average response was 2.33 ($\sigma = 1.00$), and more students disagreed with that statement after the class on plagiarism ($\mu = 2.79$, $\sigma = 1.20$; $p < .01$; Figure 2d). The final question was whether the students agreed that the repercussions were serious at University of The Bahamas, and more students agreed with that statement after the class ($\mu = 2.51$, $\sigma = 1.06$ vs. $\mu = 2.24$, $\sigma = 0.86$, respectively; $p < .05$; Figure 2e).

In addition to these questions, of note is that two additional questions also revealed an observable shift in attitudes ($p < .1$), although not at the significance level set for this study. These questions pertained to potential punishments for plagiarism: 1) that punishments in college should not be severe since students are in the process of learning and 2) that if a student lends a paper to another student he/she should not be punished. In both instances, the student opinion shifted after the class to greater agreement with stronger penalties (see Figures 3a, b).

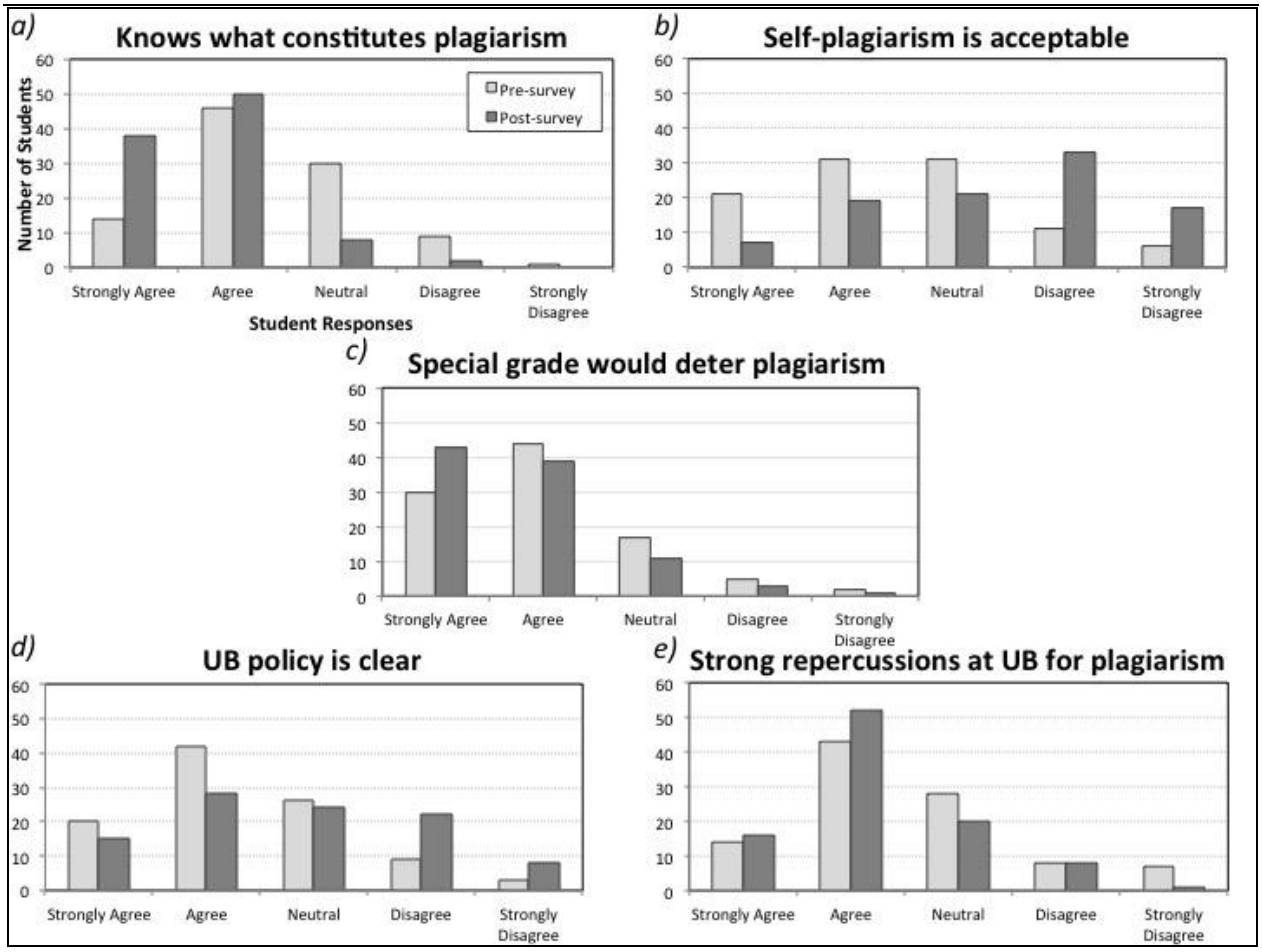

Figure 2. Survey responses to five questions on plagiarism revealed a significant shift in opinion in pre- and post-surveys ($p < .05$).

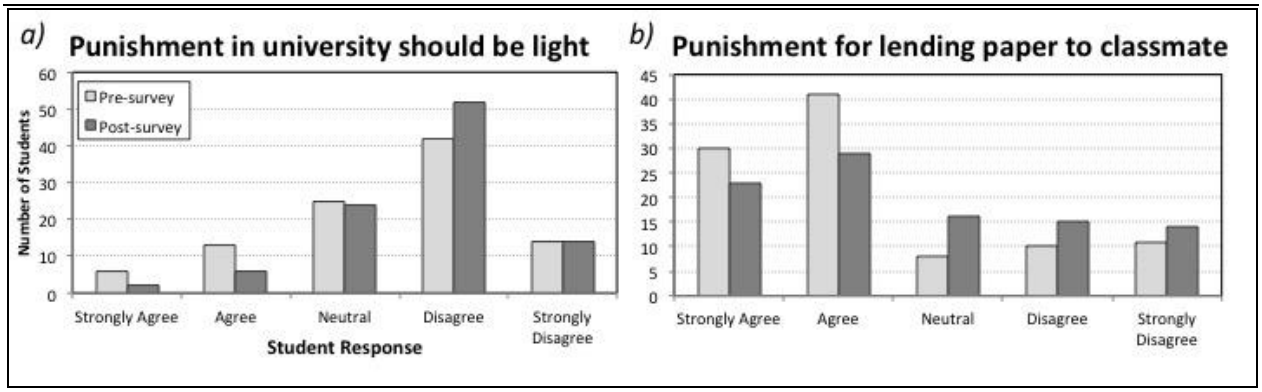

Figure 3. Survey responses to two questions on plagiarism revealed an observable shift in opinion but were above the significance level set for this study ($.5 < p < .10$).

Discussion

Based on the results of the survey administered to students before and after the class on plagiarism, overall understanding of plagiarism improved as a result of the intervention, and certain attitudes regarding plagiarism noticeably shifted. During classroom discussions, students reported that they believed plagiarism was prevalent due to heavy course loads and the feeling that they did not have the time to devote sufficient attention to each assignment. However, they still believed that this did not justify plagiarism.

The concept of self-plagiarism has been widely debated in science, and in particular has different consequences in the context of research publications and in classroom instruction. During classroom discussions, many students reported that they did not understand or agree with the concept of self-plagiarism before the class, but in general they understood the concept afterwards and felt self-plagiarism was not acceptable.

However, some students still did not agree with the concept after the class, despite understanding the concept. This viewpoint is similar to findings of previous studies conducted that show the different viewpoints among academics as to whether resubmitting assignments is considered plagiarism, as some instructors believe that using previous assignments can, in fact, improve students' understanding and should be encouraged (Bennett et al., 2011; Halupa & Bolliger, 2013; Garner, 2011). This result highlights the importance of and need for clear guidelines established by the instructor for each class at the beginning of the semester so that students are aware of what the instructor's expectations are.

Results also revealed that, with improved understanding of plagiarism, students believed that the punishments for plagiarism should be stricter in some cases. For example, after the class on plagiarism more students agreed that a special grade on their transcript would deter students from plagiarizing, perhaps due to their improved understanding of the severity of the action.

After the class, more students also disagreed with the statement that punishment in college should not be severe since they are undergoing a learning process. Finally, after the class, more students also agreed with punishing students who lend classmates papers. Therefore, a greater understanding of the concept of plagiarism could result in students understanding the gravity of these actions, thereby deterring them from committing ethical breaches and agreeing with more serious consequences.

The questions asked regarding the plagiarism policy at the University investigated the clarity of the policy and the repercussions at the University. In the first question, after the class, more students believed that the policy was unclear. During discussion, many students revealed that they had been unaware of what the policy was prior to the class, but upon reading the policy, found that the wording lacked detail, particularly in the definition of the word "plagiarism". Halupa and Bolliger (2013) previously found that university policies on plagiarism can be lacking in general. The definition of plagiarism is often disputed (Anderson & Steneck, 2011; Baker-Gardner & Smart, 2017; Bennett et al., 2011; Bouville, 2008; Pincus & Schmelkin, 2003), and even different faculty members can interpret the concept of plagiarism differently (Bennett et al., 2011). Therefore, this result underscores the importance of establishing a clear policy on plagiarism. In particular, the definition of plagiarism in University of The Bahamas' policy could benefit from clarification of what encompasses "the unacknowledged use of

another person's work" (College of The Bahamas, 1985, Section 1.2). For example, self-plagiarism is the reuse of the own student's work in another assignment, but this act is not covered under the University's current definition. Students could benefit by each instructor clearly establishing his or her policy on plagiarism at the beginning of the semester, including his or her policy on self-plagiarism.

Finally, the general question asking whether students understood plagiarism revealed a noticeable shift in self-reported understanding of the concept. In addition, discussion following the class instruction revealed that students felt they possessed a greater understanding of the concepts of plagiarism and self-plagiarism. Many students revealed that they had not been aware of the nuances and varied aspects of plagiarism prior to their instruction, similar to other studies in which students reported that they are unaware what constitutes plagiarism (Baker-Gardner & Smart, 2017; Halupa & Bolliger, 2013). Other students stated that they had not read through the specific policy, which was similar to the findings of Gullifer and Tyson (2014). Students acknowledged the value of learning the concept, as well as regret that they had not received the information earlier in their academic careers. Baker-Gardner and Smart (2017) found that students did not learn about plagiarism concepts in high school, and this lack of academic base knowledge from earlier instruction is carried forward to the university level.

With more clarification of the policy at the university level and more instruction for students on the varied aspects of plagiarism, the results suggest that incidences of plagiarism could decrease across the University. In addition, the upcoming review of the plagiarism policy (College of The Bahamas, 1985) for University of The Bahamas provides an opportunity to address the shortcomings of the policy. However, the existence of the policy does not necessarily equate to students reading and understanding the policy (Baker-Gardner & Smart, 2017). As previous studies have found that ethical instruction in scientific programs can improve students' understanding of plagiarism and benefit their careers (see Swazey et al., 1993; Brown and Janssen, 2017), this study has indicated that an opportunity exists to educate students about the various facets of plagiarism at an earlier point in their studies to benefit them throughout their academic and scientific career. Many students revealed that they were not fully aware of the concepts of plagiarism, or cognizant of the many different nuances, providing additional insight as to why plagiarism may occur in the university setting. Given the indication of increased prevalence of plagiarism within the Caribbean (Walcott, 2016), this study reveals that additional focused instruction on plagiarism for science students has the potential to combat this pernicious problem.

Conclusions

As the repercussions of plagiarism in the scientific community can be serious, students need to receive effective instruction on the concept of plagiarism during their academic careers. In this study, students revealed misunderstandings about the concept of plagiarism and felt the policy at the University was unclear. After one class period of instruction, including assigned readings before class, an online tutorial session or critical writing assignment, and an in-class lecture and discussions, students indicated a better understanding of the concepts related to plagiarism. Given the prevalence of plagiarism at the University and the effectiveness of classroom instruction after one class, this instruction could be incorporated into additional

learning opportunities during University orientation and in other classes.

Future work on this topic could evaluate the effectiveness of additional exposure to plagiarism instruction in the university setting, such as instruction over several class periods, incorporating plagiarism education in lower level classes (such as during freshman year), or including plagiarism instruction in various disciplines. Furthermore, the upcoming review of the *Policy on Plagiarism* at University of The Bahamas could benefit the University by enhancing understanding of the nuanced concepts of plagiarism across faculty and students, reducing the instances of plagiarism in classes and after students leave the University, and clarifying the expectations of the University, while strengthening its standing as a research-focused institute.

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